Gradients and relative values are considered to be reliable.

SEA LEVEL PRESSURE — This element is one of the most frequently recorded but is one of the least accurate because of instrument and coding errors. Barometers used on shipboard require more frequent calibration than they usually receive to be capable of registering accurate pressure readings. Despite the inaccuracies of the individual readings, however, the large scale patterns and mean gradients are relatively accurate.

AIR TEMPERATURE — Air temperature readings recorded on transient ships in warm, sunny weather appear to be consistently high. The reason is thought to be improper instrument exposure.

VISIBILITY — It is difficult to measure visibility at sea because of the lack of reference points. Also, some observers report reduced visibilities at night because of darkness. The coarseness of the coding intervals, however, tends to minimize serious biases in the summarized data.

WAVE DATA — Waves are the least often recorded element in marine observations. Also, the estimate of wave heights is very subjective and depends upon the experience of the observer and the size of the ship from which the observation is taken. Wave heights reported by most transient ships tend to be underestimated in comparison to those recorded by Ocean Weather Stations and dictated by the synoptic situation.

Despite the lower confidence level in the individual values of these elements, through subjective analyses and keying to the OWS data, the means, extremes and gradients presented by the isopleths are considered to be quite reliable.

THE ISOPLETH ANALYSES

The climatic data in this atlas are presented by isopleths (lines connecting points of equal magnitude) supplemented by graphs and tables.

The isopleth analyses were completed cooperatively by a team of analysts under the general supervision of the author. The basic maps were automatically plotted from one or two degree square summaries for the entire ocean area. The Ocean Weather Station data were used as bench marks.

As a further aid to data interpretation, the analysts made use of the observation count which was plotted with all summarized data. Additionally, continuing reference was made to the marine atlases and supplemental publications listed in the bibliography.

Deviations from the data computed for the representative areas and the one and two degree subsquares were in all cases discussed and evaluated by the Editorial Committee before the analyses were finalized.

THE GRAPHS AND TABLES

To supplement the isopleth analyses, graphs and tables are presented for each of the Ocean Weather Stations and the representative areas.

The graphs and tables, in most instances, represent the objective compilation of available raw data for specified areas without regard to suspected biases or inconsistencies.

THE INDIVIDUAL SURFACE CHARTS

The legend in the lower right corner of each chart is designed to explain chart content — the graphs, isopleths or both. Detailed instructions telling how to read the graphs are given and explanatory notes are included as far as practicable. The following paragraphs contain additional remarks likely to be of interest to those called upon to interpret the charts and graphs and provide answers to specific operational questions.

Most of the graphs and tables are presented in a form to facilitate the approximate determination of the empirical probability of the occurrence of selected criteria. This is an important factor in assessing the risk involved in operational planning. For certain elements for which means may be estimated from the isopleth analyses, sample standard deviations are given on the graphs providing a measure of the relative variability of the parameter or element values. The standard deviation on these graphs is denoted by a lower case sigma (σ) with a subscript (e.g., "p", which identifies pressure as the element). The standard deviation was computed using the expression:

$$\sigma_x = \left[\frac{N \sum_{i=1}^{N} x_i^2 - \left(\sum_{i=1}^{N} x_i\right)^2}{N(N-1)} \right]^{1/2}$$

where N denotes the number of observations in the sample and x_i denotes the ith value of the random variable **X**. The use of (N-1) in the denominator gives the best estimate of the population standard deviation.

SURFACE WINDS

Surface wind is the element most commonly observed and recorded. It was the element considered basic in the selection of representative areas for construction of complete frequency distributions.

Wind distribution is presented by means of a combination of two graphic forms — the bar graph and the contingency table. The bar graph corresponds to the percent scale at the top of the square and gives ready reference to the wind direction frequency. The contingency table gives the percent frequency of each wind speed class within each direction. By adding the totals lines at the bottom of the graph it is possible to determine cumulative percent frequency of wind speed below the selected threshold values. In the example chart in the legend, **71%** of all winds were $<$**17** knots.

Because of the continuous record at the Ocean Weather Station locations, it is possible to compute duration statistics for gales. These graphs are printed over or immediately adjacent to the respective locations of the OWS's in the base chart. The legends are self explanatory and show durations of wind $\geq$**34** knots as well as recurrence intervals.

AIR TEMPERATURE

The threshold values of $\leq$**0 °C** and $\geq$**20 °C** for the isopleths of air temperature were selected in response to requests by a number of users consulted who considered these as operationally significant.

The mean temperature for each wind direction and calm are shown by dots in the graph opposite each direction and corresponding to the temperature scale at the bottom. Note the temperature range on the scale may vary from area to area and month to month. Also, the scale shifts to larger intervals in a few cases because of the larger range of values for that particular area or month.

T-H INDEX AND TEMPERATURE EXTREMES

The American Society of Heating and Ventilating, as early as **1923**, introduced a term called "effective temp-